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THE PROBLEMS OF THE PHOSPHATE FERTILIZER INDUSTRY AND THE DEVELOPMENT OF FERTILIZING IN AFRICA*

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* The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. This document is a translation of an unedited original.

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I. INTRODUCTION

The fertilizer industry is currently going through a worldwide crisis.

In global terms, the supply of fertilizer is greater than consumption, a situation which, according to the forecasts of FAO (1986), is likely to outlast this century.

This is particularly true of the special case of phosphate fertilizer in Africa.

This situation is paradoxical, because, during the same period and according to the same sources, Africa will be increasingly affected by malnutrition: per capita food production declined by 9 per cent between 1970 and 1980 in Africa, whereas in the rest of the world it increased by 5 per cent.

The close relation between fertilizer consumption and increased food production no longer needs to be demonstrated, to the point where, according to a recent study conducted by FAO in 16 developing countries,* fertilizer can rightly be considered the spearhead of agricultural development. (1)

The purpose of the data and considerations put forward in this paper is to demonstrate that this situation is paradoxical in appearance only. However, it should first be recognized that the crisis affecting the phosphate fertilizer industry and fertilizing in Africa in general cannot be dissociated from that currently affecting the continent's agricultural sector as a whole.

Following a brief review of basic facts concerning fertilizer supply, requirements and demand - both potential and solvent - an attempt will be made to identify the main obstacles to growth in the consumption of this commodity by African farmers.

Proceeding from that basis, conclusions will then be drawn as to the implications for development strategies in the fertilizer industry in Africa and the concrete measures to be adopted at the various stages of the fertilizer supply chain in the African countries for the benefit of an expanding African agricultural sector.

II. PHOSPHATE FERTILIZER SUPPLY, CONSUMPTION, REQUIREMENTS AND DEMAND IN AFRICA

2.1. Mining and production of natural phosphate

The production of natural phosphate obtained in 1984 and forecast for 1989 in Africa accounts for 32-36 per cent of world production (see table 1).

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* Bangladesh, Brazil, Egypt, Indonesia, the Republic of Korea, Malaysia, Mexico, Nepal, Nigeria, Pakistan, the Philippines, Sri Lanka, Turkey, Yugoslavia, Zambia, India.

Table 1

Production of natural phosphate in Africa

(millions of tons)

	1984	1989*
N.W. Africa	27	41
N.E. Africa	11	21
S.W. Africa	6	9
Africa total	44	71
World production	138	198
Africa as a percentage of world	32%	36%

(Source: 2a.)

North-West Africa alone accounts for 20 per cent of world production.

Morocco is the largest exporter, while Tunisia processes 80 per cent of its own phosphate into fertilizer.

There are plans to expand or restore mining facilities at Khouribga (Morocco) and Sra Ouer ne (Tunisia), and - on a more modest scale - at Minjingu (Tanzania) and Sukulu Hills (Uganda).

Deposits in Burkina Faso, Mali and Niger are worked with very low intensity. Lastly, evaluations of phosphate resources have been conducted in Burundi and Zambia, while resources identified in Angola, Guinea-Bissau and Mauritania have proved the most substantial.

As shown on the attached map supplied by the International Fertilizer Development Centre (IFDC), Africa has many deposits and considerable mining capacity. Although the latter is mainly concentrated in North Africa, West Africa (Senegal, Togo) is also fairly well represented, and the same will soon apply to the African countries south of the equator (Zimbabwe and South Africa already having a significant mining capacity).

Table 2

Production of natural phosphate in West Africa

(millions of tons)

Senegal	1.9 in 1985
Togo	2.4 in 1985

Figure 1. Phosphate Deposits of Africa
(Source: IFDC)

2.2. Fertilizer production capacity and consumption

In Africa as a whole, phosphate fertilizer production capacity is well in excess of consumption of this commodity, whereas the production capacity for nitrogenous and potash fertilizers is below consumption levels (see table 3).

Table 3

Fertilizer production capacity (N, P_2O_5, K_2O), consumption and balance for Africa during the period 1984/85

(millions of tons)

	Supply*	Consumption	Balance
N	0.22	0.72	- 0.50
P_2O_5	2.44	0.58	+ 1.86
K_2O	0	0.28	- 0.28

(Source: 2b.)

Table 4 shows that more than half the phosphate fertilizer production capacity in Africa is to be found in Morocco, but, taking into account the levels of production achieved, only 20 per cent of that country's capacity was utilized in 1982/83.

Table 4

Phosphate fertilizer production capacity and extent of utilization (in percentage terms): 1982/83

(thousands of tons, P_2O_5)

	Capacity	Output	Utilization rate (%)
Algeria	165	48	29
Côte d'Ivoire	n.a.	3	-
Egypt	115	93	81
Morocco	1 485	296	20
Nigeria	20	7	35
Senegal	23	16	70
Tanzania	25	2	8
Tunisia	872	495	57
Uganda	-	-	-
Zimbabwe	20	15	75
Total	2 725	935	Average 34

(Source: 2b.)

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* Supply of N, P_2O_5, K_2O in the form of fertilizer, after subtraction of consumption in forms other than fertilizers, normal fluctuations in stocks, and losses connected with processing and distribution.

In overall terms, the production of phosphate fertilizers in 1982/83 accounts for only 34 per cent of the installed capacity.

What are the likely trends?

Many countries are installing additional production capacity:

In Morocco, the Jorf Lafsar complex will produce 1 million tons of DAP, 400,000 tons of TSP and 200,000 tons of ammonium sulphate phosphate (domestic market);

In Tunisia there are two projects, M'dilla and La Skira, which will produce 400,000 tons of TSP and 330,000 tons of DAP and complex fertilizers;

In Egypt, the Abu Zaabal complex will increase its phosphoric acid production capacity by 65,000 tons per year;

In Senegal, since 1983, 264,000 tons of phosphoric acid and 693,000 tons of sulphuric acid have been produced in factories, part of this output being used for the production of 165,000 tons per year of DAP, 224,000 tons per year of TSP and 80,000 tons per year of various types of complex fertilizers. The fact that the remainder of the acids produced is intended for export gives rise to severe financial and marketing problems in current market conditions.

Many other countries have plans for setting up factories: in Nigeria (project postponed to 1988/89), in Uganda (80,000 tons per year of TSP) and in Togo, Ghana and Gabon, to mention only manufacturing plants for phosphate and complex fertilizers.

Also in this context, the forecasts for 1989/90 made by FAO clearly reflect a still greater surplus balance between supply and consumption in phosphate fertilizers in Africa, on the assumption, it should be stressed, that solvent demand for fertilizers is maintained at a comparable level.

Table 5

Estimated fertilizer production capacity (N, P_2O_5, K_2O), consumption and balance for Africa during the period 1989/90

(millions of tons)

	Supply	Consumption	Balance
N	0.73	0.94	- 0.21
P_2O_5	3.99	0.80	+ 3.19
K_2O	0	0.36	- 0.36

(Source: 2b.)

In conclusion it can thus be said that Africa has abundant phosphate resources which are widely distributed throughout the continent. According to the estimates of FAO, by the beginning of the 1990s Africa will account for 36 per cent (or 71 million tons) of world phosphate production, and will thus become the principal world producer, ahead of the United States, whose production will by that time be fluctuating around 65 million tons.

It will have a significant phosphate fertilizer production capacity - 4 million tons P_2O_5 equivalent - which seems to indicate a considerable surplus in relation to estimated consumption in the continent - 0.8 million tons P_2O_5 equivalent. This production capacity will, however, be less than one tenth (9 per cent) of world installed capacity (approximately 43 million tons P_2O_5 equivalent).

This very general situation of imbalance, which is disquieting for the future, calls for a more precise analysis of the current fertilizer consumption levels in the light of potential needs. In addition, there should be better identification of the demand expressed by the potential "clients" (farmers in Africa) and the reasons which prevent this demand being expressed in effective form.

As will be seen, Africa is not suffering from an overcapacity in regard to the production of phosphate fertilizers, but it does show a dramatic under-consumption of fertilizer products.

III. POTENTIAL NEEDS AND FARMERS' DEMAND FOR FERTILIZERS

Annexed is a survey carried out in 1983 by FAO on fertilizer consumption per cultivated hectare in 37 African countries: such consumption is in the region of 11 kg/ha of ($N + P_2O_5 + K_2O$) and 8 kg/ha of ($N + P_2O_5 + K_2O$)* if Swaziland, where the level of fertilizer consumption is exceptional (74N, $37P_2O_5$, $33K_2O$ kg/ha), is not taken into account.

In the same year Western Europe supplied 224 fertilizer units per hectare under cultivation, and Asia 168 units.

Table 6

Consumption of fertilizer constituents in kg/ha under cultivation in 1983

	Africa	Western Europe	Asia
N	4	109	127
P_2O_5	4	57	34
K_2O	2	58	8
TOTAL	10	224	169

(Source: 2b.)

While this comparison is revealing, it is rather imprecise - since it relates to continents which are geographically very different - as a basis for trying to determine potential fertilizer needs in Africa more accurately. It should be emphasized that such an exercise is inevitably in large part arbitrary, since

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* N: 3.4 kg/ha; extreme values 0 and 30.3.
P_2O_5: 2.8 kg/ha; " " 0 and 21.3.
K_2O: 1.4 kg/ha; " " 0 and 57.6.

it must be borne in mind that the 2,886 million hectares of this vast continent, the 52 countries involved, the extreme heterogeneity of settlement and the variety of physical environments and resources scarcely permit one to arrive at ideas and concepts which are of general application.

At the same time, we think it would be worth while to draw attention to some features of Africa (rural and urban) which should condition future expression of demand for fertilizers in the continent as well as the development strategy of the fertilizer industry.

3.1. The Africa of tomorrow and its potential fertilizer needs

Africa, which in 1979 had a population of 427 million, can expect to have approximately 828 million inhabitants by the beginning of the twenty-first century (5a).

This very high demographic growth (3 per cent per year) is accompanied by large-scale recent urbanization which is also very rapid, a factor which makes Africa fundamentally different from Asia.

In a recent survey (3) of the 47 African countries south of the Sahara, this explosive development trend is assessed.

	1950	1980	2010
Total population (47 countries) (millions of inhabitants)	176	370	954
Rate of urbanization	12%	30%	56%

Despite urbanization, the rural population, taking into account the high rate of demographic growth, will continue to increase (population multiplied by 1.50 between 1980 and 2010).

As a result of this phenomenon of urbanization, but also for reasons relating to history, environmental conditions (rainfall, endemic diseases, marginal soils) and access routes, Africa today has a great diversity of rural population densities, a situation which will be still more pronounced in the future (cf. figure 2).

This demographic evolution and this heterogeneity of settlement have already two consequences which directly affect potential African demand for fertilizers: a very high level of demand for foodstuffs, and a high risk of environmental degradation.

The very high demand for foodstuffs results from the curve of demographic growth. This demand is associated with a need for growth in agricultural productivity, a good indicator of which is given by the evolution in the relationship between the non-agricultural population and the agricultural population in each country. According to the survey mentioned above, while in 1950 a farmer had to provide food, in addition to his own subsistence, for 0.18 non-agricultural inhabitants, the ratio had risen to 0.45 in 1980, and would reach 1.21 in the year 2010.

At present agricultural productivity in Africa, with all the reservations made earlier with regard to such generalizations, is one of the lowest in the world, if it is assessed in terms of kilograms of foodstuffs produced per hour of agricultural labour.

2.1

The picture in the year 2000

Rural* population densities per km^2

< 2

2 to 20

20 to 100

> 100

* Population living in centres with less than 5,000 inhabitants

(Source: 3.)

For example, it is estimated in 1987 that, as regards cereals production, 10 hours per hectare per year of work are required to produce 10 tons per hectare of grain in the wheat-growing areas of Beauce; in contrast, in the savannah zone south of the Sahara an average of 100 days is required to produce 0.5 tons of grain per hectare: the productivity of labour in this African cereal-growing zone is thus in the region of one thousandth of what it is in the major agricultural countries of Europe or North America.

There are many reasons for this, but the almost total absence of inputs and equipment (mechanization) obviously acts as a major obstacle to the necessary intensification.

One of the consequences of the high rate of urbanization is also the change in the actual structure of demand for foodstuffs: more wheat, rice and maize, more fruit and vegetables, and more meat (particularly poultry).

Now the traditional patterns of nutrition (cf. figure 3) of the rural African populations south of the Sahara show a diet which is basically made up of starchy foods, very low in fats, and most often deficient in proteins except in the Sahelian stock-rearing zones.

Diversification and the necessary introduction of more demanding crops (maize in comparison to millet or sorghum) or more intensive ones (vegetables, proteaginous crops) should be taken into account in evaluating potential needs for fertilizer products.

The second consequence of demographic trends in Africa is the danger of degradation of soils and of the tree cover as a result of the fact that the dwindling availability of land eliminates the long fallow periods needed for their regeneration after years of exhausting cultivation (little or no organic and mineral replenishment).

This dwindling availability of cultivable land, particularly in zones of high rural population density, also leads farmers to cultivate vulnerable land which has traditionally been left uncultivated, so that erosion sets in, imperilling the surrounding terrain.

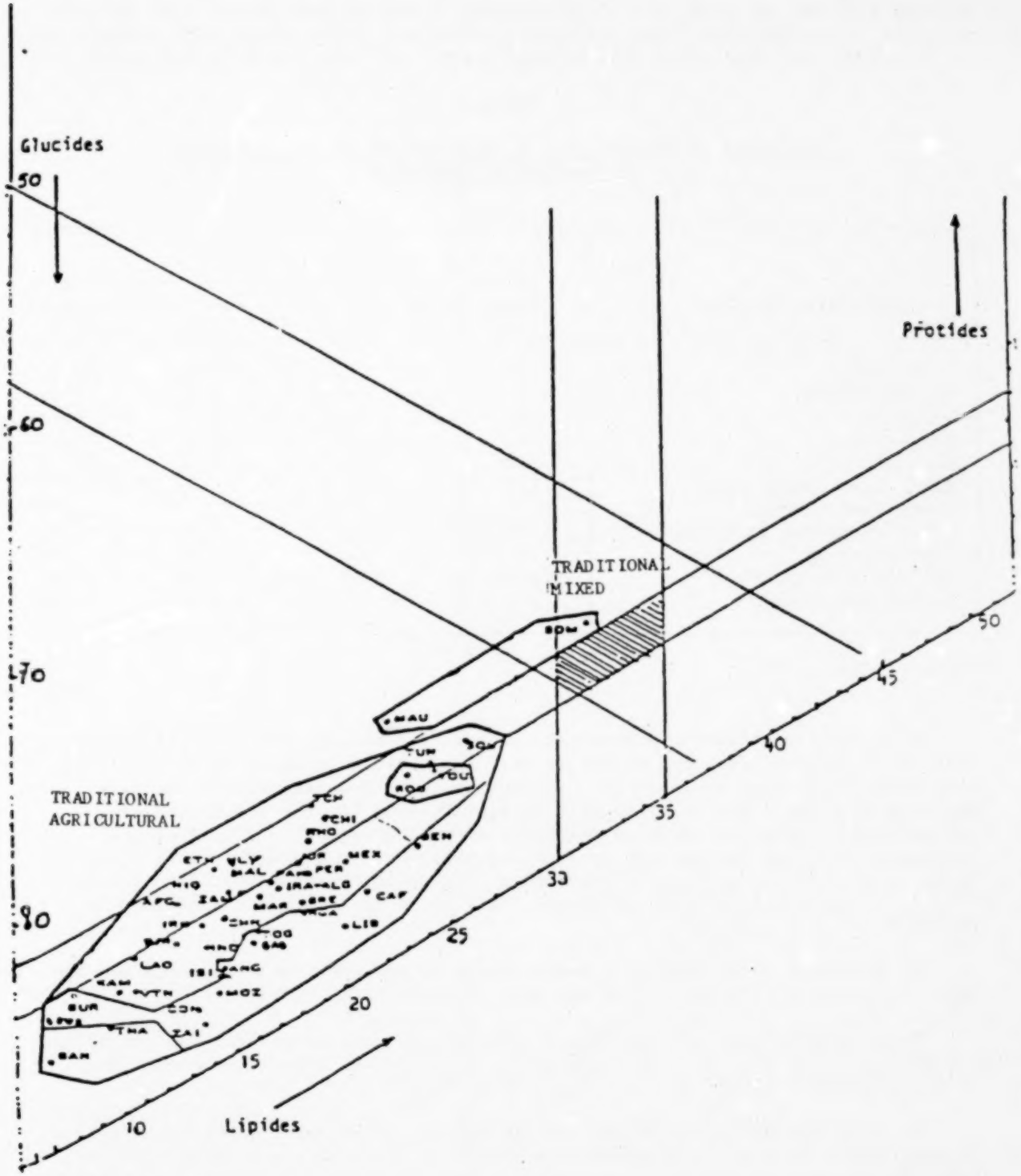
The study carried out by CIRAD, currently in course of publication (4), on fertility trends in the savannah zone south of the Sahara indicates that fertilization, by increasing the vegetable matter present per surface unit and by encouraging, under certain conditions, the accumulation of humus in the soils, plays a major role in the protection of African agricultural land.

In concluding this brief account it should first of all be remarked that it is not really possible or desirable to make too clear a separation between the problems of the phosphate fertilizer industry and those relating to the fertilization in general of soils and crops in Africa - or, for that matter, those linked to the utilization of other production factors (cf. table 7).

Secondly, it is no less evident that, in view of the current situation of African agriculture, its likely development and the three priorities which follow from these (intensification, diversification and protection), the potential fertilizer needs appear to be very considerable.

An assessment by country, climatic zone and type of crop-growing system can be made, and attention can be drawn in this connection to the interesting work carried out by IFDC in this field (6).

Figure 3. Traditional patterns of diet: nutritional triangle



(Source: 3)

In its study Agriculture: Toward 2000, FAO explores two scenarios - one favourable, the other less favourable - and takes the view that, in order to achieve its agricultural production objectives, Africa must increase the quantity of fertilizer applied to the fields by 8.5 per cent or 7.3 per cent annually between 1980 and the year 2000. This amounts to saying that by the year 2000 the potential phosphate fertilizer needs would be 4 to 5 times higher than consumption in the 1980s, and would thus fall between 2 and 3 million tons P_2O_5 equivalent.

Table 7

Estimated production factor requirements in the year 2000
(90 developing countries)

Production factors	Year 2000 A (Index. 1980 = 100)	Year 2000 B (Index. 1980 = 100)	A (per cent per year)	B (per cent per year)
Arable area	120	115	0.90	0.71
Irrigated area	141	129	1.72	1.27
Tractors	162	146	2.43	1.91
Fertilizer	553	417	8.92	7.40
Pesticides	514	412	8.53	7.33
Agricultural machinery	240	207	4.47	3.70
Commercial energy (in petroleum equivalent)	494	383	8.32	6.94
Improved seed	317	280	5.93	5.29
Cereals (livestock)	304	258	5.71	4.85
Labour (man/days)	146	137	1.91	1.60

(Source: 5a.)

It is also possible to make a very general estimate of how much phosphate fertilizer would be required to ensure that the total cultivated land in Africa (168 million hectares in 1980 (5a), an area which will be assumed to increase annually by a net 1 per cent) is able to provide food for the population of 828 million in the year 2000 (on the basis of an equivalent of 250 kg of grain per inhabitant, and taking into account the fact that an average of 1 kg P_2O_5 is required per 100 kg of grain produced). The estimate shows that 2.1 million tons P_2O_5 equivalent would be required. This is in line with the preceding estimate.

It should be noted that this would permit an average supply for each hectare under cultivation (205 million by the year 2000) of 10 kg of P_2O_5.

This average input of phosphate fertilizers is very low, since the preceding estimate is based only on crop requirements and does not take into account the initial endowment of the soils in this constituent.

In fact, agronomists consider that an average of at least 45 kg/ha of P_2O_5 is required to "correct" the deficiency in the soils of Africa. These cover at least 30 per cent of the cultivable area of the continent (7 - 1980). If such an additional supply was made available (over 30 per cent of the cultivated area in

the year 2000), this would lead to a new "potential requirement" of 2.8 million tons P_2O_5 equivalent, and thus to total potential requirements of 4.9 million tons P_2O_5 equivalent! From 1984/85 to the year 2000 it would therefore be necessary for the annual growth rate of phosphate fertilizer consumption to increase by 15 per cent, which is probably an unrealistic target in many countries.

In any event, such overall estimates are not primarily intended to provide the basis for a development strategy for fertilizers in Africa - for example, in zones in which the nature of the soils and the density of the rural population make it possible to identify the highest requirements for those inputs. They are rather aimed at posing the problem of fertilizer development in Africa, which is well illustrated by the example of phosphate fertilizers, which can be summarized as follows.

Africa produces phosphate fertilizers which are not purchased in situ. Yet this fertilizer supply corresponds quite well to the requirements of the African continent, which should indeed increase its fertilizer production capacity in order to meet the requirements of intensifying and diversifying its agricultural foodstuff production and of ensuring the protection of its land resources.

Accordingly, the principal question to be answered is the following: why do African peasant farmers make such little use of the fertilizers they are offered?

3.2. Difficulties affecting fertilizer use by African farmers

The previous question gives rise to others. The following fundamental questions arise with regard to phosphate fertilizers:

Is the proposed fertilizer properly suited to the soil and the crop: is it effective, does it have no harmful side-effects?

Are African farmers fully informed and aware of the role of fertilizer in enhancing the productivity of their labour in physical terms (yield) and in economic terms (income)?

Can African farmers purchase the fertilizer currently offered?

3.2.1. Agronomy

In response to the first question, numerous agronomic studies provide a rich harvest of experimental evidence regarding the effectiveness of phosphate fertilizing in Africa (cf. the scientific publications of the various national and international agricultural research institutes based in Africa). With reference to Africa south of the Sahara, emphasis should be given to certain particular aspects of the role of phosphates:

In contrast to the South American continent, which is geologically quite similar to the African continent, phosphate fertilizers are scarcely retrograded by irreversible physico-chemical fixation on the mineral colloids in the soil. With the exception of certain pedological formations found in the high Malagasy plateaux and in Central Africa (lateritic soils, highly desaturated or "gibbsihumox"), the phosphate fertilizers applied remain readily available to the crops. It is probable that the extensive geological movements - which flattened out the African substratum, particularly during the last glaciations - and the strong dominance of residual siliceous materials in the surface layers are behind this differential behaviour of soils in Africa (soluble silica tends to occupy the phosphate ion fixation sites).

Africa possesses extensive areas of soils that are acid or may easily be acidified (8) when they are brought under cultivation.

In agronomic terms, this means that the phosphate fertilizers have an appreciable residual effect beyond the first year of application, all the more so as the phosphorus is naturally not leached in the soil. Moreover, the soluble tricalcic natural phosphates are particularly suitable for the improvement of acid African soils (9). Even though they are less soluble than TSP or MAP/DAP, they often show very satisfactory annual effectiveness, even in low-acid Sudano-Sahelian environments, probably because of the low-concentration but continuous presence of silicic acid in the solution of sandy soils, which encourages the solubilization of natural phosphates.

Apart from this favourable indirect effect on soil acidity and aluminic toxicity, phosphate fertilizing (10) is also known for the part it plays in stimulating root growth (which is important in zones of water or mineral stress) and for its impact on improving symbiotic nitrogen fixing by leguminous plants, without the drawbacks (acidification, accelerated mineralization of organic matter in the soil) of nitrogen fertilizing, for example.

In conclusion, phosphorus is a particularly useful element for African soils and crops, without harmful side-effects. Quite the contrary - phosphate fertilizers have a clear direct and subsisting effect because most predominantly siliceous soils in Africa (quartz sands) are low in phosphorus and lack any appreciable phosphorus-fixing capability. In these frequently acid or easily acidifiable soils, soluble natural phosphates give good results.

3.2.2. The problem of fertilizer acceptance on the part of farmers

Although this is not always clearly expressed, many promoters of agricultural projects imply that there is still a great need for information and training for African farmers in the area of fertilizer use.

On the other hand, many agronomists working in the field consider that farmers no longer need to be convinced of the yield increase produced by (suitable) mineral fertilizers.

In view of these divergent opinions, the situation needs to be clarified by a closer analysis of the structuring of the rural sector in various categories of primary farming population. The SCET/BDPA report (11) on the formulation of a common agricultural policy for the West African Economic Community (WAEC) provides interesting data on this subject and there is reason to assume that they may be transposed to the entire African continent (cf. annex 2).

The authors show that the primary population may be broken down into three categories:

(a) The periurban primary population, brought about by the drift from the countryside to the urban centres. This segment, which accounted for under 3 per cent of the total primary population in 1950, will reach 30 per cent by the year 2010. This segment is very sensitive to market conditions and is a priori very favourable to any factor that increases agricultural productivity, such as fertilizer.

(b) At the other extreme, there are the so-called "marginal" primary populations (defined as those living 200 km from any major urban area) which of necessity adopt inward-looking modes of production and consumption and are, consequently, resistant to any innovation from outside. This segment, which still

represents 15 per cent of the total population of the ECOWAS States (and 30 per cent of the population of WAEC alone), will drop to a mere 3 per cent of the total population by the year 2010. However, more than 40 per cent of the rural population of certain States (Mauritania, Mali, Niger) will still fall into this "marginal" category by the year 2010.

It is clear that it will be very difficult or very expensive to achieve progress in productivity (and income) in these last-mentioned cases without an integrated subregional development policy.

(c) Lastly, the intermediate primary populations - the category of farmers currently in the process of intensification (e.g. the cotton-growing zone of West Africa) - are very open to intensive farming practices. In 1980 this group represented 50 per cent of the total population, a figure which will rise to over 60 per cent by the year 2010.

To conclude, although it was certainly necessary in the 1950s to carry out technical extension programmes to popularize fertilizer use in the countryside, where 30-40 per cent of the population was then made up of a marginal primary population which was not very open to technical progress, it has become unnecessary in the 1980s and 1990s to continue such a costly effort which really has no impact on the great majority of farmers who no longer need to be persuaded of the role of fertilizer use in increasing yield.

This does not mean to say that no more efforts need to be made to develop and disseminate more effective fertilizing practices (forms of application, spreading techniques) and fertilizer products suited to particular conditions (acid soils, dry regions, very intensive cropping, etc.) to enable the fertilizer to achieve optimum efficiency under peasant farming conditions (with the crucial problem of weed control when farming work is done manually or with little mechanization but fertilizers are applied).

This brief overview confirms that the reason for the low level of fertilizer consumption in Africa cannot be explained by agronomic causes related to the technical development of farming.

3.2.3. Obstacles connected with the economic environment

The development of agricultural productivity is directly linked with that of fertilizer consumption. As we have already seen, the only true potential market for fertilizers in Africa is for food products, where demand is increasing all the time. Even though industrial crops may receive more and better fertilizers, one cannot expect any great changes in the volume of fertilizer consumption for crop-growing systems that already receive generalized fertilizer application (90 per cent of areas under cotton in West and Central Africa receive mineral fertilizer) and in which one cannot reasonably expect appreciable expansion in future (international competition).

Experience over the past 25 years shows that, irrespective of food crisis situations in the countryside, which are less generalized in Africa than one might think, the motive force behind any trend towards increased productivity in agricultural production of foodstuffs in a country is not the search for national food self-sufficiency, but essentially the prospect for farmers of increasing their income and standard of living.

This finding is in line with the most recent analysis of the economic and food situation of developing countries made by macro-economists of international renown (5b). After noting the close link between individual purchasing power and

satisfaction of the food requirements of the inhabitants of developing countries, they have concluded that the main cause of malnutrition in those countries is not an inadequate supply of food products or production factors, but insufficient purchasing power. They then show that the most reliable and effective way to correct this situation is to establish a dynamic and prosperous rural sector to generate peasant purchasing power and a margin of self-financing in the sector at the lowest cost.

Four conditions then have to be fulfilled to develop a productive and profitable agricultural sector:

Establishment of a clear and voluntarist agricultural policy;

Existence of a logistic, commercial and financial (credit) infrastructure tailored to the rural sector;

Agricultural prices that are realistic and provide a return for farmers;

Availability of intensification "technology packages" suited to agricultural production conditions.

Until these four largely interdependent conditions are fulfilled it is unlikely that a peasant farmer will go beyond the satisfaction of his own food needs and take an interest in agricultural intensification. The latter will seem to him to entail too many economic risks which he alone will have to bear.

The problem of Africa is that, in most countries, the four conditions indicated above are still far from being satisfied. In this context there is certainly an obligation, or a temptation, for States to seek a solution, at the risk of increased dependence, in a strategy of imports or food aid aimed at the international market.

As a result of the charges levied on imports and the profits made from the sale of food aid products, this system may help to balance shaky budgets and satisfy urban dwellers accustomed to new food habits.

It has a certain logic and international aid must take it into account so that countries which really wish to break away from the apparently easy course of systematic food support and to commit themselves to a national agricultural policy aimed at food security are not thereby penalized compared with the others. We shall return later to the practical implications of this observation while nevertheless stressing the fact that there is a basic conflict between food aid of a systematic nature and the development of national fertilizer demand.

In the case of the countries choosing the "agricultural priority option" it is thus essential for the rural infrastructure to be improved and in some instances created: access and means of transport, organized markets, storage infrastructure, credit structure tailored to the nature and to the (climatic) risks of farm production (mutual guarantees by farmers' groups).

In this field, as in the field of agricultural policy discussed earlier, some suggestions will be put forward in the following chapter, but much has already been said and written on these complicated subjects affecting the entire process of agricultural development.

In our opinion, the essential point is that all proposals made regarding national or international structures should aim at increasing peasant farmers' income.

From the standpoint of the farmer who opts for a system of intensive food production, the required policies are clear:

> Among all the various intensification factors he needs (fertilizer, pesticides, improved seeds, machinery), the farmer must be able to acquire, in good time (the rainy season does not wait), suitable fertilizer (formulation, presentation) at the lowest possible cost;
>
> He must also be able to sell the surplus production brought about by his intensification effort at a price offering him a return.

3.3. General conclusions on fertilizer consumption and the development of agriculture in Africa

This analysis leads one to the conclusion that the problems of the production of fertilizers, and above all the phosphate fertilizers for which Africa possesses both raw material resources (raw phosphates) and a significant production capacity, are closely linked to those of promoting a productivist approach to agriculture in Africa.

At a macro-economic level and also from the point of view of the farmers' interests, the development of a prosperous and dynamic rural sector is considered by the experts to be the best chance for the economic development of the countries concerned.

There is therefore both a hope and a need to develop fertilizer consumption, currently very low, in Africa.

This development is possible because there is substantial potential demand among peasant farmers.

However, the farmers' current economic environment does not provide sufficient motivation for them to purchase more fertilizer.

In order to get the situation in Africa moving again, it is necessary to provide low-priced fertilizer and/or to increase the purchasing power of farmers, who must draw more profit from the sale of their surplus food production resulting from increased agricultural productivity.

In addition to a firm general policy by the State to promote national food production, it is important that farmers should direct this production without delay to the needs of urban consumers. In comparison with the rural food diet these needs differ in kind (grilled maize rather than millet gruel, rice, vegetables, etc.), presupposing a cultural diversification, and in terms of quality, presupposing the emergence of an industrial capacity for the processing and packing of farm products which will help add to the value of those products.

IV. FERTILIZER COSTS AND INDUSTRIAL DEVELOPMENT STRATEGIES FOR FERTILIZERS IN AFRICA

In adapting peasant food production to new urban demand, the fertilizer industry can hardly have a direct impact. It can and must, however, play a major role in reducing the cost of fertilizer delivered to farmers.

Many studies have been made on the cost of fertilizers in Africa, particularly under the aegis of FAO.

We include a summary table of fertilizer costs in 1985 from the point of manufacture or import to the farm gate (table 8).

Some examples speak for themselves:

Gambia buys urea on the international market at $100 per ton and the cost delivered to the farmer is $217; Zambia also buys urea on the international market, but pays $255 per ton and the cost delivered to the farmer is $422;

The N-P-K complex (16-16-16 or 17-17-17) reaches the Malagasy farmer at $343 per ton, whereas it costs $693 per ton to reach his counterpart in Rwanda.

Thus the cost of moving the product from the factory to the place of import and then to the distribution centres and to the consumers is enormous. It is generally far higher than the production cost of the fertilizer itself (1.5 times).

This situation has led several countries to establish systems of subsidies.

The recent study entitled "Role of fertilizer pricing policies and subsidies in agricultural development", FAO/FIAC, 1987 (1), makes a very interesting point regarding this controversial question of fertilizer subsidies.

The authors stress that there can be scarcely any doubt that, in countries where food security is really not ensured, the fertilizer subsidy to reduce the cost of this input to an acceptable level for peasant farmers remains a necessity.

However, the subsidies are now becoming so great a burden for Governments that, according to the authors, they must be reduced, if not eliminated, wherever this does not bring about a famine situation. This is frequently possible by reducing taxes, excessively high rates of interest or the exaggeratedly high transfer price of locally-available raw material (e.g. phosphates).

C. Fayard, taking this analysis further, shows that it is indeed possible, without a subsidized system, to make suitable fertilizers available to farmers at low cost. This objective requires only one condition to be met: an enterprise logic must be applied to the entire fertilizer branch.

Three production strategies are then identified: international, regional and national.

In the context of the great variety of situations encountered in Africa, each strategy has its benefits and its appropriate area of application.

In the case of countries which possess phosphate resources, it is argued that it may be technologically possible and economically justified to promote the emergence of a new fertilizer production or processing capacity either nationally or subregionally.

Starting from a proper analaysis of peasant farmer demand, identifying the types of fertilizer (particularly phosphate fertilizers) most suited to the soils and to the crops, taking advantage of the flexibility of small industrial installations which adapt better to variability in conditions of supply of basic raw materials or semi-finished products (DAP, urea, KCl, etc.) and thus reducing the investment costs and the logistic costs (location at or near the places of consumption), there seems indeed to be room for this new and complementary capacity for manufacturing diversified fertilizers intended essentially for internal national or subregional markets.

Table 8

Summary table of fertilizer marketing costs ($US per ton), 1985

	East and Southern Africa				North-East Africa		Central Africa		West Africa			South America	
	Madagascar (16-16-16)	Tanzania (Urea)	Zambia (Urea)	Zimbabwe (AN)	Somalia (Urea)	Sudan (Urea)	Rwanda (17-17-17)	Zaire (f)	Burkina Faso (15-20-15)	Gambia (Urea)	Ghana (AS)	Argentina (Urea)	Nicaragua (t)
Import (CIF) or ex-factory price	219 a/	240 a/	255 a/	164 b/	215 b/	138 a/	252 a/	241 a/	318 b/,g/	100 a/	103 a/	107 b/	226 b/
(For land-locked countries only Marketing costs to the border)	-	-	75	-	-	-	173	-	27	-	-	-	-
Transport costs	56	124	47	20	17	40	41	44	41	11	42	12	67
Storage costs	5	2	8	-	6	8	59	17	...	6	4	3	...
Handling costs	10	14	7	4	7	9	2	1	6	4	15	3	21
Physical losses	6	2	4	2	14	5	19	22	-	7	3	1	4
Taxes and levies	1	-	-	-	1	46	5	15	20	-	-	6	-
Interest costs	9	37	5	2	-	-	79	-	-	6	18	6	18
Promotional expenses	-	-	...	-	-	-	-	1	-	1	-	-	-
Other costs	14	3	4	7	1	1	3	1	-	12	2	-	-
Importers'/ wholesalers' margin	10	39	-	13	11 d/	56	36	6	10	40	14	10	7
- Retail margin	13	25	17	30	-	e/	24	e/	-	30	9	-	41
TOTAL MARKETING COSTS	124	246	167	78	57	165	441	107	104 h/	117	107	41	158
Total cost	343	486 c/	422	242	272	303	693	348	422	217	210	148	384
Retail price	286	Variable	243	242	239	303	489	348	296	202	109	148	384
Subsidy	57	-	179	-	33	-	204	-	126	15	101	-	-

Notes: - = nil, ... = negligible.
a/ Import (CIF) price.
b/ Ex-factory price.
c/ An additional charge of $49 is made on imported fertilizer to support high production costs of TFC.
d/ All fertilizer in Somalia is distributed on an ad hoc basis by FAO and other projects which absorb some costs. The margin quoted is nominal.
e/ Included in wholesale margin.
f/ Average of all imports.
g/ Ex-factory Abidjan, Côte d'Ivoire.
h/ Probably understates true costs, which are absorbed by the cotton marketing organisation, SOFITEX.

Consequently, in an "ascending" approach to the question of the fertilizer industry in Africa, i.e. starting from the real demand on the part of potential consumers, and not a "descending" view which imposes a logic and constraints peculiar to heavy industrial structures, one arrives at the conclusion that, to deal with the variety of rural development problems in Africa, there must be an equal variety of industrial solutions "offering technologies, products and services of varied and appropriate size". (12)

What answer can one give to those who consider that the emergence of a national or subregional production or processing capacity (which may mean rehabilitating or restructuring existing production capacities) implies a reduction in fertilizer exports to those countries?

While such a conclusion may seem self-evident, we think that a situation similar to that noted in regard to the cereal trade during the 1970s may be expected. Kellog (1985, quoted by Dorfman and Falcon) has provided extremely interesting evidence that those developing countries having chosen to give priority to agriculture are in fact those which make most use of world trade in food products.

Considering the technologies envisaged (complex partial attacks) in these new industrial installations, the vast potential fertilizer requirements, the development of new, demanding crops and the increase in cropping intensity (several crops each year from the same field, e.g. market garden crops), it is very probable, on the contrary, that the consumption of raw materials, semi-finished products and complex fertilizers purchased on the international market will not diminish but rather increase appreciably.

To bring this chapter to a close, it must be reiterated that, in the case of those countries which are firmly committed to agricultural intensification and increasing peasant farmers' income, nothing can be decided or undertaken in the area of fertilizer industry development without a global, multisectoral and imaginative approach to the entire fertilizer branch.

This approach starts with the farmers, that is to say with the fertilizer consumers. As with any product that one wishes to sell, it is necessary to start with a serious "market study". The target population is diversified, professionally unorganized, sometimes up against crisis situations and changing constantly, and motivations are not well enough known to all those participating in the countries' fertilizer policy.

It thus seems essential that peasant farmers should organize and develop professional structures and make their voice heard.

It is also important to have a place for the collection of all information needed in political decision-making. This must be provided nationally and subregionally since there are many complementarities at the latter level relating to demand, production and consumption of farm products and fertilizers (and other inputs).

It is also at subregional level that it is easiest to solve problems concerning relations with the outside world, whether with regard to food aid, customs protection or regulation or regional and international financing.

A dynamic approach to the problems of fertilizer production also presupposes that all means will be used to identify, train and support managerial personnel in Africa who will be able to promote a business-like approach in the fertilizer industry.

V. RECOMMENDATIONS

These recommendations concern three objectives:

Better evaluation and stimulation of national fertilizer demand;

Optimization of production and processing capacity for fertilizers in order to meet demand (nationally and, above all, subregionally);

Reorientation of international aid in favour of aid to the factors and conditions of production to ensure optimum utilization of fertilizer by agricultural producers.

In general, these objectives will be pursued by supporting, on a contractual basis, initiatives taken at the most elementary possible level.

As has been mentioned several timess, there is a great diversity in the situations in African countries and their agriculture and the few suggestions set out below are above all intended to provoke thought and encourage concrete proposals rather than to impose a particular view without discussion.

(a) The national level

- Promotion of "Producer groups" (PGs) established around a common production objective (maize marketing, improved seeds, etc.). Each PG is organized on the basis of a village or a few villages bringing together about 100 persons, or about 100 hectares on which some 100 kg/ha of fertilizer are used - 10 tons per year of fertilizer per PG and 1,000 tons per year for 100 PGs.

  This will allow the emergence of profitable secondary activities in each district or administrative division: small local transport enterprises (from the district to the PG) with 5-10 ton lorries working 150 days/year to carry fertilizer (and other goods the rest of the time), small enterprises to provide services relating to storage, milling and processing and packaging of products to meet local and regional food requirements, small mechanical workshops, etc.

  Heavy transport for supplies (and removal of heavy products for marketing) to the local districts from the fertilizer factory or place of import will be provided by national-scale transport enterprises (30-40 ton lorries).

  Establishment of an assembly of PGs in each small homogeneous farming region (cotton region, maize region, etc.) bringing together:

  The chairmen of the PGs;
  The representatives of the local public authorities;
  The haulers and traders.

  At these assemblies fertilizer needs can be assessed and the PGs will undertake to buy the quantities of fertilizer needed, making it possible to fix, in compliance with administrative rules, the cost and time-table of fertilizer transport on the basis of a mutual contract between the parties involved.

  At this level an agricultural co-operative credit will be organized, based on the principle of mutual guarantees at the level of each PG (or secondary farming enterprise).

- Organization of a National Fertilizer Agency (NFA) to gather all information necessary for defining and adapting a national fertilizer strategy. These data will be collated according to norms which, if not unified, are at least coherent as between the various countries of a subregional grouping. The fertilizer industry will be associated with the work of the NFA according to rules fixed in each country.

(b) The subregional level

A subregion is taken to be a group of countries with complementary interests, representing both a market and a capacity for credible proposals vis-à-vis bilateral, multilateral and international aid and international trade.

We think it necessary for the efforts of the NFAs to be federated at this level to make it possible to draw up a coherent subregional strategy.

We propose that organizations such as WAEC, ECOWAS and the Entente Council should set up Regional Fertilizer Agencies (RFAs) - a sort of specialized committee for the fertilizer sector. Here would be located the necessary computerized facilities for the acquisition, processing, publication and dissemination of collected national data, and the necessary means for mobilizing expertise (independent experts) to assist requesting countries in the area of fertilizer use, manufacturing technology and fertilizer distribution and marketing.

The eventual objective would be, on the basis of these RFAs, to establish for Africa a structure comparable to that which has proved its usefulness in the countries of Asia and the Pacific ("Fertilizer Advisory, Development and Information Network for Asia and the Pacific", FADINAP).

Finally, at national level with regional co-ordination, certain problems would be studied, broken down and treated locally or under co-operation agreements.

We shall cite the following, without giving an exhaustive list:

In the area of research (agronomy and technology): (1) development of new fertilizer products that are inexpensive and meet the requirements of the domestic markets; (2) diversification of crops with a view to their better adaptation to urban requirements; (3) development of equipment and workshops to process and package marketable food production.

In the economic field: development of customs systems or systems to regulate trade in imported food products, selection of ways of reducing regional logistic costs, identification of "regional terminals" for the import of raw materials and semi-finished products taking optimum advantage of world market fluctuations, etc.

In the area of training, highest priority for training in the management of industrial and commercial enterprises in the fertilizer branch.

(c) The international level

Two topics merit closer attention:

- Is it possible to replace food aid by an aid for the development of fertilizer consumption which is satisfactory for States and for the various economic agents in the fertilizer branch?

  Regionally, it is certainly necessary first to provide a system of food security to cope with unpredictable crises (droughts). However, we are not

in favour of fertilizer donations or a more or less generalized system of subsidies (from the factory to the farmer) whose object is often to maintain an inadequate fertilizer branch. The idea would rather be to give supplementary facilities to countries and individuals seeking to increase fertilizer consumption, by various modalities: complementary loans granted to dynamic private entrepreneurs (fertilizer production, distribution) on the basis of a programme of satisfying national or subregional requirements and under financial conditions granted in the public domain, donation of raw materials or semi-finished fertilizer products to processing shops, access for PGs to production factors that will bring about greater efficiency of the fertilizers they purchase (fungicides, selected seeds), etc.

Thought should be given at a general level to such proposals, the aim of which would be to give a technical premium and sometimes a financial premium (loan) to fertilizer users, so that they may reap more benefit therefrom.

- The problems of the fertilizer industry, particularly the phosphate fertilizer industry, result from the fact that consumers do not have sufficient purchasing power to buy this input which is essential to the agricultural development and intensification that Africa needs.

  This touches on numerous macro-economic, micro-economic, technical and infrastructure conditions. In short, it is a complicated matter and there may even be no possibility of a durable solution if these problems are dealt with in an isolated or sequential fashion: agricultural techniques, industrial problems, commercial and financial problems, etc.

  It would thus seem useful, in clearly identified projects, to ensure still more functional co-ordination between the different international agencies, particularly FAO and UNIDO, to enable specialists with varying backgrounds and from varying disciplines to work more effectively for the agricultural development of developing countries.

  In this context there is an evident similarity between the problems encountered in the area of fertilization and the use of fertilizers to enhance soil fertility and productivity and those encountered by WHO: pharmaceutical products and medical care, which may be of steadily increasing effectiveness, are less and less accessible, because of their cost, to the populations faced with acute health problems.

  At its 1978 Conference at Alma Ata, WHO defined a "Health care" strategy (primary health care) which seems particularly well suited to the needs. The use of simple diagnostic techniques and a reduced, well-adapted and inexpensive pharmacopoeia makes it possible to protect the "health capital" of a population which can then be helped to take on responsibility for its own health.

  Should we not envisage and formulate a strategy of "fertility care" or "primary fertility techniques" for peasant farmers in Africa with their very low purchasing power and uncertain land resources with a view to achieving the long-term development of fertilizers and the rural sector in Africa?

(The local population is considered responsible for its own health and therefore capable of defining its health objectives, its priorities, its means and its methods and of taking care of itself. This basic health action must be carried on in close relationship with health centres at all levels and of all kinds.)

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Annex 1

CONSUMPTION OF FERTILIZER NUTRIENTS PER HECTARE OF ARABLE LAND AND PERMANENT CROPS, 1983/84

(kilograms)

Country	N	P_2O_5	K_2O	Total
Angola	1.1	1.1	0.2	2.5
Benin	1.7	0.8	0.5	3.0
Botswana	0.4	0.3	0.3	1.0
Burkina Faso	1.5	2.3	1.2	5.0
Burundi	0.7	0.7	0.8	2.1
Cameroon	1.8	0.6	2.3	4.8
Central African Republic	0.7	0.0	0.0	0.7
Chad	0.6	0.5	0.6	1.7
Congo	1.2	0.0	1.2	2.4
Côte d'Ivoire	2.5	1.9	6.3	10.7
Ethiopia	1.3	2.2	0.0	3.5
Gabon	1.3	0.7	3.1	5.1
Gambia	6.9	6.9	1.9	15.6
Ghana	4.0	2.5	1.2	7.7
Guinea	0.3	0.1	0.2	0.6
Guinea-Bissau	1.0	4.2	2.4	7.7
Kenya	13.4	21.3	2.9	37.6
Lesotho	1.7	13.4	0.0	15.1
Liberia	2.4	3.1	1.9	7.5
Madagascar	2.5	1.2	1.0	4.6
Malawi	10.8	4.3	1.4	16.4
Mali	4.2	2.0	1.2	7.5
Mozambique	3.1	3.7	0.9	7.7
Niger	0.4	0.1	0.1	0.5
Nigeria	4.1	3.0	1.6	8.7
Rwanda	0.1	0.1	0.1	0.3
Senegal	1.3	1.9	1.6	4.8
Sierra Leone	0.5	0.4	0.2	1.1
Somalia	1.7	0.3	0.3	2.3
Sudan	6.7	0.1	0.0	6.7
Swaziland	73.5	36.8	33.1	143.4
Tanzania	3.0	0.8	0.4	4.2
Togo	0.8	0.7	0.6	2.1
Uganda	0.0	0.0	0.0	0.0
Zaire	0.6	0.4	0.4	1.4
Zambia	8.5	3.2	1.2	13.0
Zimbabwe	30.3	16.3	11.0	57.6

(Source: 2b.)

Annex 2

PERIURBAN, INTERMEDIATE AND MARGINAL PRIMARY POPULATION

	PERIURBAN (1,000 persons)							INTERMEDIATE (1,000 persons)							MARGINAL (1,000 persons)						
	1950	1960	1970	1980	1990	2000	2010	1950	1960	1970	1980	1990	2000	2010	1950	1960	1970	1980	1990	2000	2010
Côte d'Ivoire	64	120	278	680	1 300	2 340	4 000	1 319	1 614	2 532	3 230	3 800	4 400	3 630	900	930	1 150	1 250	1 100	400	150
Mali	40	62	136	260	480	790	1 200	1 720	2 078	2 474	3 020	3 860	5 090	6 000	1 350	1 650	1 950	2 250	2 150	1 500	800
Upper Volta	24	44	94	209	400	640	960	1 886	2 346	3 406	3 751	4 080	4 360	4 620	1 400	1 600	1 100	1 000	900	850	800
Senegal	82	132	248	472	830	1 380	2 100	1 478	1 628	2 042	2 178	2 030	1 740	1 230	500	600	700	650	600	550	500
Niger	22	34	76	140	260	470	800	1 153	1 434	1 907	2 690	3 680	4 790	5 530	900	1 150	1 500	1 950	1 700	1 150	800
Mauritania	3	6	24	86	166	260	380	425	496	575	589	564	530	410	300	400	450	400	350	300	250
WAEC	235	398	856	1 847	3 436	5 880	9 440	7 981	9 596	13 026	15 458	18 014	20 910	21 420	5 350	6 350	6 850	7 500	6 800	4 750	3 100
Benin	28	50	100	246	486	804	1 240	852	1 080	1 260	1 294	1 214	1 196	890	550	600	650	550	400	150	50
Togo	22	38	82	144	260	440	720	600	677	891	1 203	1 460	1 780	1 730	450	550	550	550	450	200	80
Gambia	4	5	12	36	64	104	156	133	138	173	202	246	316	294	100	150	200	200	150	50	20
WAEC and Observers	289	491	1 050	2 273	4 246	7 228	11 556	9 566	11 491	15 350	18 157	20 934	24 202	24 334	6 450	7 650	8 250	8 800	7 800	5 150	3 250
Nigeria	1 060	2 160	4 280	7 800	13 200	21 600	32 200	21 450	26 490	32 910	37 830	42 680	44 370	42 960	5 600	4 850	3 850	1 700	1 050	650	400
Ghana	118	305	505	940	1 540	2 440	3 760	2 232	3 595	4 195	5 560	6 320	6 550	6 090	1 250	1 300	1 000	700	400	250	150
Guinea	48	90	164	300	500	800	1 240	1 402	1 510	1 836	2 280	3 560	4 480	4 820	1 050	1 100	1 200	1 300	550	250	100
Sierra Leone	30	47	86	164	292	500	800	912	1 164	1 451	2 018	2 418	2 880	3 080	600	550	500	200	150	100	50
Liberia	24	38	61	120	230	420	740	295	410	588	796	1 020	1 200	1 240	300	350	400	400	350	300	250
Guinea-Bissau	13	20	20	32	54	90	148	194	269	329	436	536	660	692	200	250	200	150	100	50	50
Cape Verde	5	8	12	15	20	28	36	75	83	96	103	120	112	104	100	100	100	100	100	100	100
ECOWAS	1 587	3 159	6 178	11 644	20 082	33 106	50 480	36 126	45 012	56 755	67 180	77 588	84 454	83 260	15 550	16 150	14 500	13 350	10 500	6 850	4 350